THE ABSORPTION OF HIGH ENERGY QUANTA

BY

GAIL DAYTON ADAMS, JR.

B.S., Case School of Applied Science, 1940
M.S., University of Illinois, 1942

ABSTRACT OF THESIS
SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
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THE ABSORPTION OF HIGH ENERGY QUANTA

In 1934, Bethe and Heitler[1] published a theory on the production of electron-positron pairs by high energy quanta. For lack of a controllable-energy source of sufficient energy, the cross-section for this process has not been checked against the theoretical prediction. It is of considerable theoretical as well as experimental interest to know how well the prediction of Bethe and Heitler is obeyed in the energy interval between 10 and 20 MeV.

Absorption measurements have been made for quanta of the high energy tip of the Bremsstrahlung spectrum from the 20 MeV. betatron[2]. The tip is isolated by using the photo neutron process of the nucleus. The elements used were copper and iron because they have convenient thresholds[3].

Reaction	*Threshold*	*Half-Life*
$_{29}Cu^{63}(\gamma,n)_{29}Cu^{62}$	10.5 MeV.	10.3 min.
$_{26}Fe^{54}(\gamma,n)_{26}Fe^{53}$	14.0 MeV.	8.9 min.

Both Cu^{62} and Fe^{53} are positron-active. The activity is measured with a sensitive detector. In one group of experiments this was a Lauritsen electroscope, in the other it was a thin-walled Geiger-Müller counter.

Placing an absorber of varying thickness between monitor and detector sheets of either copper or iron, and running the betatron at a known energy above the threshold of the sheets, the absorption, hence the absorption coefficient, is determined when the ratio of the relative activity, detector to monitor for a finite thickness of absorber, to that with no absorber is known. The absorbers used were carbon, aluminum, iron, and lead. A correction was made for the secondary Compton quanta the energy of which is sufficient to produce activity in the detector.

The results check the predicted cross-section within 1%. Since the observed absorption coefficient at these energies consists of Compton effect plus pair production, the agreement with predicted values must be taken as confirmation of the extreme-relativistic simplification of the Klein-Nishina formula as well as of the pair-production cross-section.

1. H. A. Bethe & W. Heitler, Proc. Roy. Soc., **146**, 83 (1934).
2. D. W. Kerst, Rev. Sci. Inst., **13**, 387 (1942).
3. G. C. Baldwin, Thesis, University of Illinois, 1943.

PART II

In this section, a group of experiments were performed at the request of the National Defense Research Committee, the nature and results of which are of a restricted nature for the duration of the war.

VITA

Gail Dayton Adams, Jr., was born January 27, 1918, in Cleveland, Ohio. He attended elementary and high school in that city. He studied at Case School of Applied Science, receiving the degree of Bachelor of Science in Physics in 1940. From 1940 to the present time he has attended the University of Illinois, where he held a teaching assistantship during 1940-1942 and a research assistantship in the Engineering Experiment Station during 1942-43. He received the degree of Master of Science from this institution in 1942. He is affiliated with the American Physical Society, Tau Beta Pi, Phi Kappa Phi, Pi Mu Epsilon, and the Society of the Sigma Xi.

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